

The shock-absorber role of the internal public debt in Colombia, 1923 - 2003

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Abstract

The hypothesis that the internal public debt has played the role of shock absorber in Colombia since 1923 is modelled. 1923 was an important landmark in the history of fiscal and monetary reforms in Colombia during the twentieth century. The econometric results offer a strong support for the hypothesized shock-absorber role of the internal debt.

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Public economics: Debt (H63)
Economic History: Latin America (N16)

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The shock-absorber role of the internal public debt in Colombia, 1923 - 2003²

This paper seeks to model the hypothesis that the internal public debt (henceforth IPD) has played the role of shock absorber in the Colombian economy. The period chosen was 1923 – 2003. 1923 was an important landmark in the history of fiscal, monetary and other institutional reforms in Colombia during the twentieth century.

We build a model based on the government budget constraint in which the dependent variable is the deviation from trend of the IPD. The explanatory variables are shocks on the sources of tax revenues (output and imports), shocks on government expenditures, and shocks on external financing. These shocks are also modelled as deviations from the historical trends. The model shows that when output, imports, government expenditure and external financing grow at their historical rate, the IPD grows at the rate of the economy.

We follow standard econometric methods for evaluating the estimated model. It is shown how the sample period estimation satisfies prevailing criteria regarding statistical and economic interpretation of the estimated parameters. Based on the estimation results, we describe and historically illustrate the cycles of the IPD during the period of study.

We start with a brief reference to relevant economic paradigms which guide our interpretation of the econometric estimations.

A. The paradigms.

Despite major analytical differences, three lines of thinking offer a general guidance for the empirical work, namely, the Keynesian model of fiscal deficits, the life-cycle hypothesis (LCH) with its implications for fiscal policy choices, and the tax-smoothing model of deficits.

Regarding the Keynesian model, we refer to the Keynesian-Lernerian principle of "functional finance"³. In this framework, a balanced budget over the business cycle is

^{2/} Department of Financial Stability. Banco de la República. Bogotá, Colombia, April, 2005. The original version of this essay was written at the University of Glasgow in 1988, as one of the econometric sections of the doctoral dissertation. At that time, the sample of data of the relevant variables covered the period 1925 – 1985. The paper was updated with the generous research assistance of Daniel Osorio. This is the tenth of a series of papers about the Colombian debt since 1820 up to 2000. All the papers are available at the webpage of the Banco de la República (www.banrep.gov.co). The support given by the Banco de la República is gratefully acknowledged.

^{3/} Bator (1987)

the outcome of deficit policies during recessions and surplus policies during prosperity. The stabilization of the economy is the criterion invoked to assess budgetary policies, and taxes and government expenditures are active policy instruments.

As for life-cycle theories, a central concern is the ability of budgetary policies to redistribute welfare between generations. In order to preserve a balanced budget over the business cycle, life-cycle exponents advocate discretionary and procyclical tax rates. What is behind this position is a defence of the principle of intergenerational equity. It is asserted that generations benefited by tax reductions during depressions are the same who finance increased tax rates and surpluses at high activity levels⁴.

The tax-smoothing model argues for cyclically invariant tax rates. Deficits during recessions and surpluses during prosperity result from automatic fiscal stabilizers. Fiscal deficits during depressions are interpreted as optimal responses of the economic system to temporary low-income periods⁵.

As seen, the three paradigms favour a balanced budget over the cycle as a whole, but fiscal activism or discretionary policies are ingredients of the Keynesian or the life-cycle prescriptions which do not find room in the tax-smoothing theory. These alternative theoretical positions determine the expected coefficients in applied work. While the tax-smoothing framework predicts unitary coefficients (in absolute value) for changes in public debt due to shocks on output and government expenditures, the other two frameworks predict a coefficient greater than one in the case of output, and less than one in the case of government expenditures⁶.

Our empirical work is different from what is usual in the literature, since instead of considering the stock of total debt (or the changes in this variable) as a function of other economic variables, we separate out the internal debt from the external debt, and treat the former as the dependent variable, and the latter as one of the explanatory variables. Essentially, we emphasize the shock absorber role of IPD, and highlight the exogenous nature of external financing.

The historical documentation of the Colombian experience reveals that the internal debt and the external debt are not perfect substitutes. While the latter is largely determined by the cycles of private foreign credit and the availability of developmental loans, the former is constrained by limited domestic financial markets and restricted access to the credit of the central bank. For years (1923 – 1990), only under exceptional circumstances (deep recessions, wars), and after ad hoc parliamentary legislation, would the government had access to extraordinary lending from the central bank. Finally, since a constitutional reform in 1991, the central bank is not allowed to make loans either to the government or to the private sector. These specific aspects of our study do not invalidate the applicability of the 'paradigms', however, but extend their application. For instance, our model below discusses not only the textbook countercyclical role of the

^{4/} Modigliani (1986)

^{5/} Barro (1979)

^{6/} This last assertion is more explicit in an LCH framework where on grounds of intergenerational equity it is expected that a temporary increase in government expenditures should be partly financed by increased taxation. In a Keynesian context the expected coefficient could be less or equal to one depending on the mix of debt and taxes chosen by authorities.

internal public debt concerning output fluctuations, but also its countercyclical function regarding shocks on external financing to the economy as a whole.

B. The model.

To begin with, we refer to the government budget constraint as the starting point for our discussions on the IPD.

A simple expression for a government budget constraint which discriminates between external and internal debt is

$$dF + dF^* = (G - T) + rF + r^*F^*$$

where dF and dF^* represent the changes in the real stocks of the internal and the external debts respectively, $(G-T)$ is the real primary deficit, and r and r^* are the real interest rates on the internal and the external debts respectively. Regarding tax revenues, T , we highlight the crucial historical importance of imports in the tax base. Based on those facts we propose to make an explicit differentiation between imports and other sources of tax revenues which for simplicity we relate to output. Bearing these considerations in mind, a simple two-period government budget constraint can be represented as follows:

$$(F_t - F_{t-1}) + (F^*_t - F^*_{t-1}) = rF_{t-1} + rF^*_{t-1} + G_t - \tau(Y+M)_t \quad (1)$$

where the terms in parentheses on the left-hand side are the changes in the internal and the external debts respectively, r is a constant real interest rate applicable to both the internal and the external debts, G_t is the real flow of government expenditures exclusive of interest payments, and τ is the tax rate equally applied on real output (Y) and real imports (M).

Equation (1) gives the change in F_t and F^*_t between any two equal periods of time. By solving this equation forward it is possible to extend the analysis to a finite period (T) or to the infinite horizon ($T \rightarrow \infty$). Assuming for simplicity that the government has an infinite time horizon, and imposing the transversality conditions

$$\lim_{i \rightarrow \infty} F_{t+i} / (1+r)^i = 0 \quad (2)$$

$$\lim_{i \rightarrow \infty} F^*_{t+i} / (1+r)^i = 0$$

the intertemporal budget constraint is

$$F_{t-1} + F^*_{t-1} = \sum_{i=0}^{\infty} [\tau(Y+M)_{t+i} - G_{t+i}] (1+r)^{-(i+1)} \quad (3)$$

The two equations in (2) state that neither the stock of internal debt nor the stock of external debt grow faster than the interest rate forever. Equation (3) means that the

present value of primary fiscal surpluses to be obtained in the infinite horizon is exactly equal to the sum of the initial stocks of the internal and the external debts.

The discussion of the government budget constraint can be extended by considering the steady-state case in which the variables Y_t , M_t and G_t grow all at the same rate, n . The actual values of these time series fluctuate around a trend which grows at the common rate n . The present values of these series are calculated by using the Gordon model of corporate finance (Copeland and Weston, 1988), according to which the present value of a series X growing at a constant rate n (assumed to be less than r) is given by

$$X^P = (r-n) \sum_{i=0}^{\infty} X_{t+i}(1+r)^{-(i+1)}$$

Therefore, the normal or permanent values for the variables under discussion are as follows

$$Y_t^P = (r-n) \sum_{i=0}^{\infty} Y_{t+i}(1+r)^{-(i+1)} \quad G_t^P = (r-n) \sum_{i=0}^{\infty} G_{t+i}(1+r)^{-(i+1)} \quad (4)$$

$$M_t^P = (r-n) \sum_{i=0}^{\infty} M_{t+i}(1+r)^{-(i+1)}$$

By substituting the permanent values Y_t^P , M_t^P and G_t^P from (4) into (3), the intertemporal budget constraint can be rewritten as

$$F_{t-1} + F_{t-1}^* = [\tau Y_t^P + \tau M_t^P - G_t^P]/(r-n) \quad (5)$$

Now, by substituting from (5) into (1) where we have previously added and subtracted the same amounts nF_{t-1} and nF_{t-1}^* leads to the following expression for the two-period government budget constraint:

$$(F_t - F_{t-1}) + (F_t^* - F_{t-1}^*) = \tau(Y_t^P - Y_t) + \tau(M_t^P - M_t) + (G_t - G_t^P) + n(F_{t-1} + F_{t-1}^*) \quad (6)$$

where the $(X^P - X)$ terms represent shocks on the corresponding variables. The shocks on Y_t and M_t appear weighted by τ , thus giving the deviations of Y_t and M_t from their trend values as a proportion of the normal amount of revenues.

At this point we can introduce some rearrangements and modifications which will prove useful in our empirical analysis. First we can rewrite the government budget identity in terms of the IPD as follows:

$$[F_t - (1+n)F_{t-1}] = \tau(Y^P - Y)_t + \tau(M^P - M)_t + (G - G^P)_t - [F^*_t - (1+n)F^*_{t-1}] \quad (7)$$

Since n is a constant growth rate, the presence of n on the left-hand side represents a single increment of the internal debt at rate n . The same applies to the external debt on the right-hand side. Then, equation (7) shows that in the absence of shocks on output, imports, and government expenditures, and provided that the external debt does not grow at a rate different from n , the IPD will grow at the trend growth rate of the economy [$F_t = (1+n)F_{t-1}$]. Second, since we are interested in the analysis of a period of eighty years, instead of a single increment between two periods, it is convenient to apply a constant rate of continuous compounding to the variables F_t and F^*_t ; these constant rates are the corresponding trend growth rates of F_t and F^*_t . Therefore, (7) may be rewritten as

$$(F - F\sim)_t = \tau(Y^P - Y)_t + \tau(M^P - M)_t + (G - G^P)_t - (F^* - F^*\sim)_t \quad (8)$$

where $F\sim$ and $F^*\sim$ stand for the trend values of F and F^* . Equation (8) is the basis of our empirical analysis. The terms $(X - X^P)$ result from the detrending process of each variable in (8). Such a process is explained in Appendix A. The same applies to the terms $(F - F\sim)$ and $(F^* - F^*\sim)$. The next step is to formulate an estimating equation for the model in (8). This is what we do in the following subsection.

C. Empirical analysis.

The empirical equation to be applied to annual observations over the period 1925-2003 is

$$Fu_t = a_0Fu_{t-1} + a_1Yu_t + a_2Mu_t + a_3Gu_t + a_4fu_t + K + e_t \quad (9)$$

(+) (-) (-) (+) (-)

The dependent variable Fu_t represents estimated deviations from trend of the IPD. Similarly, the explanatory variables are also estimated deviations from trend of the corresponding variables. All the variables are in logarithms with the exception of fu_t (estimated innovations for external financing scaled by exports) because this series is sometimes negative. K is a dummy variable. As seen in Figure 1a below, the series increases substantially and suddenly in 1962, and also in 1983. The reasons for these big changes were institutional. In 1962 the central bank incurred in heavy losses in the foreign exchange market, and the government accepted to incorporate them as part of its public debt. At the beginning of 1983, as part of a package of fiscal reforms, the government decided to resign to some revenues which came from a Special Foreign Exchange Account. Such a reduction in fiscal incomes was compensated by extraordinary loans of the central bank to the government. And, e_t is an error term.

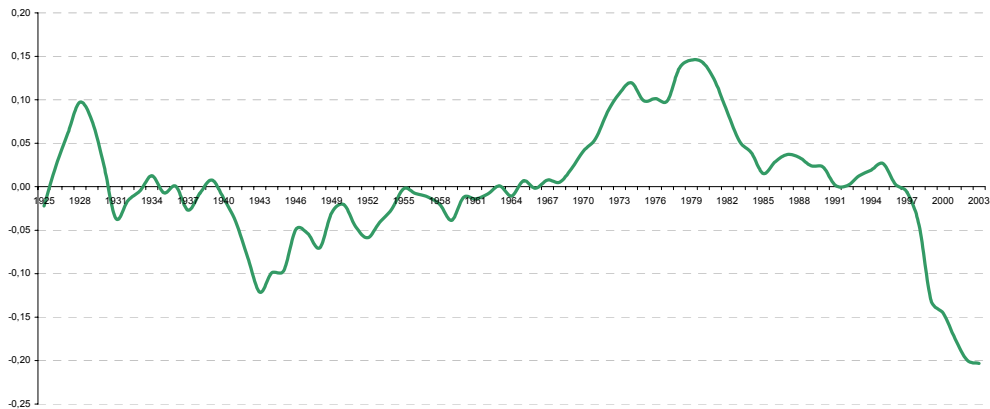
The time paths of the regressand and regressors in equation (9) are described by individual graphs in Figure 1. The evolution of Fu_t appears in Figure 1.a. The original series corresponds to the year-end nominal stocks of the IPD between 1925 and 2003. The real values of the series were obtained by using the GDP deflator. The evolution of Yu_t is shown in Figure 1.b. The original series is the annual values of GDP in real terms. The time path of Mu_t appears in Figure 1.c. The original series is the year-end values of real imports in US\$. The time path of Gu_t is depicted in Figure 1.d. The original series excludes interest repayments, and its real value was obtained by using the GDP deflator.

FIGURE 1a
REAL INTERNAL PUBLIC DEBT
ESTIMATED RESIDUALS
 (deviations from trend in logs)
 1925-2003



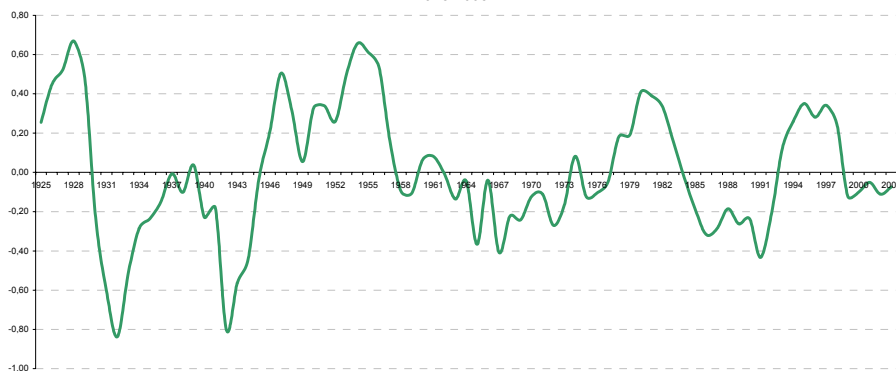
Sources. Informe Financiero del Contralor (Contraloría General de la República, annual) for the original nominal data of the IPD. National Accounts edited by DANE for the GDP deflator.

FIGURE 1b
REAL GDP
ESTIMATED RESIDUALS
 (deviations from trend in logs)
 1925-2003



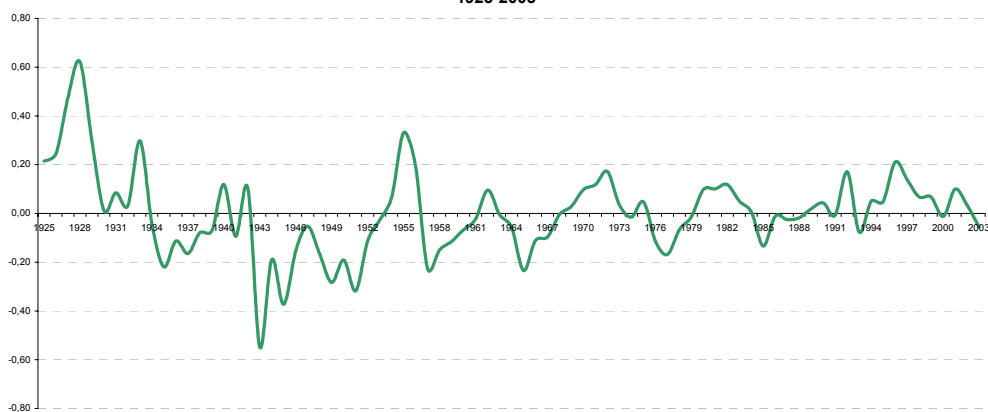
Sources: CEPAL (1957) for the original data from 1925 up to 1957. And DANE for the original data up to 2003, and the corresponding GDP deflator.

FIGURE 1c
REAL IMPORTS
ESTIMATED RESIDUALS
 (deviations from trend in logs)
 1925-2003



Sources. Informe del Gerente a la Junta Directiva del Banco de la República (annual), from 1924 up to 1985. Since then, Banco de la República, Revista (mensual).

FIGURE 1d
REAL GOVERNMENT EXPENDITURES
ESTIMATED RESIDUALS
 (deviations from trend in logs)
 1925-2003



Sources: Informe Financiero del Contralor (Contraloría General de la República, annual) for the original data on government spending.

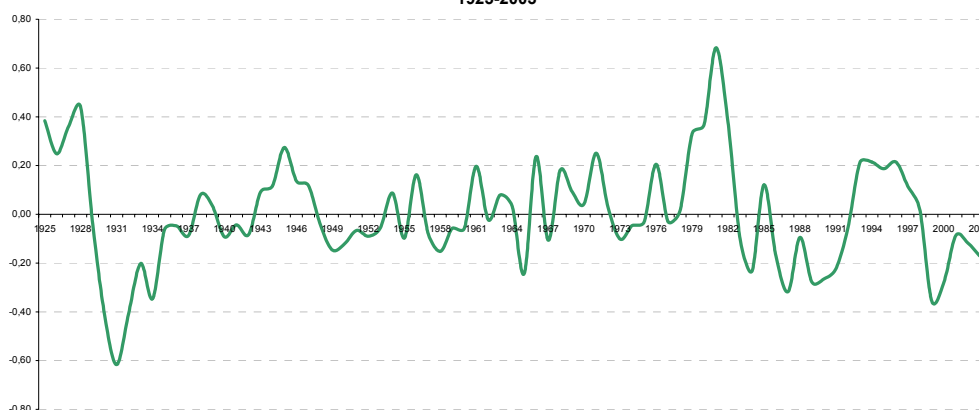
The time path of $f u_t$ is portrayed in Figure 1.e. The flow of external financing f includes not only the flow of foreign lending to the national government dF^* (which we used in our discussion of the government budget constraint, above), but also foreign lending to the rest of the public sector and the private sector; these concepts are net of interest repayments abroad. Additionally, f includes the flow of foreign direct investment. In our estimating equation (9) we use this concept of f rather than a

narrower one which only includes the foreign lending to the national government. The reason for this choice is that, it is the collapse of net foreign financing to the country, and not only to the national government, which encourages the reaction of the IPD.

1. Expected signs.

Consider first positive (negative) shocks on GDP which lead this variable to grow above (below) its trend. The IPD is expected to grow below (above) its trend, and therefore the expected sign is negative. A similar consideration can be made regarding shocks on imports, since custom revenues have been of critical importance in the composition of total tax revenues. The IPD is expected to grow below (above) its trend when imports grow above (below) their own trend, and thus the expected sign is negative. Regarding government expenditures, it is expected that temporary deviations from trend will cause the IPD to deviate from trend in the same direction, and therefore the hypothesized sign is positive.

FIGURE 1e
NET EXTERNAL FINANCING
ESTIMATED RESIDUALS
 (deviations from trend in logs)
 1925-2003



Notes. Net External Financing is defined as $(dIR - TB)/X$, where dIR : change in international reserves; TB : trade balance; and X : exports.

Sources. Informe del Gerente a la Junta Directiva del Banco de la República (annual), from 1924 up to 1985. Since then Revista del Banco de la República (monthly publication).

The term a_0Fu_{t-1} accounts for lagged effects of the growth rate of internal debt. We expect that the current deviation of internal debt from trend should be a positive function of its lagged value. Figure 1.a brings out a notable persistence of periods in which internal debt grows above its trend. We explain this behaviour as a result of institutional factors associated with the maturity structure of the IPD. Historically, after episodes of extraordinary increases of the internal debt (particularly in the 1930s and 1980s) governments transformed their substantially enlarged short-term financial obligations into long-term liabilities.

Finally consider the term $a_4f'u_t$. The IPD is expected to grow above (below) its trend, whenever the flow of net external financing to the country grows below (above) its trend. This hypothesized relationship is derived from the fact that governments resort to

internal financing to cushion the impact of changes in external financing on the economy. The proposed sign is negative.

2. Expected coefficients.

How can we interpret the coefficients in equation (9)? As for the coefficient of the lagged dependent variable a_0 , the expected coefficient is strictly greater than zero, and strictly less than one. a_0 is expected to say what percentage of the lagged deviation from trend of the IPD in a given period persists to the next period. Regarding the output's innovations coefficient a_1 , consider the case in which tax revenues T depend on a proportional income tax and a constant tax rate ($T=t \cdot Y$). When only built-in fiscal stabilizers are at work, and the deficit is only financed with internal debt, the hypothesized coefficient is $a_1=1$. This is the magnitude of a_1 postulated by the tax-smoothing theory. Alternatively, when automatic stabilization is reinforced by procyclical changes in tax rates the expected coefficient is $a_1>1.0$. Finally, a coefficient $a_1<1$ cannot be discarded if in the event of automatic stabilization part of the deficit is financed with external debt; if this is the case, although tax smoothing applies, the model cannot be informative about that result.

The discussion of the expected magnitude of a_2 is somewhat more complicated. Governments alter tariffs not only for fiscal purposes. There may exist protectionism and/or balance-of-payments reasons for changing tariffs' levels. These reasons could be put forward regardless of whether imports are growing at their normal rate or above or below that rate. In general, revisions of tariffs seek to satisfy a combination of interests; for instance, protectionism and fiscal revenues. Some possibilities can be described in order to postulate expected magnitudes of a_2 . The simplest case is that in which given a constant tariff, collected duties rise (fall) when imports grow at a higher (lower) rate than their normal. This is a tax-smoothing case which yields $a_2=1$; the important assumption is that for instance in the case of a fall in collected duties the government does not have access to or does not use external credit to finance the emergent deficit.

A second possible case postulates $a_2<1$. Two options may be considered. One is the illustration just given in which the tariff level is kept constant regardless of positive or negative cycles of imports; the difference is that in this instance governments finance part of the ensuing deficit (when duty revenues fall) with external credit and the remainder with internal debt. The final effect is tax smoothing, though the model itself cannot inform about that result. The model only shows the direct response of internal debt to shortfalls in imports. The alternative option considers a mixture of increasing internal debt and higher tariff levels, and possibly some external financing. To sum up, a coefficient $a_2<1$ indicates that a hypothetical negative fiscal effect of a downturn in imports is partly financed by an increase in internal financing but is inconclusive about the behaviour of tariffs.

Under a tax-smoothing framework, governments use public debt to finance temporary and unexpectedly high expenditures. A coefficient $a_3=1$ is expected under the assumption that governments avoid affecting tax rates during emergency periods and finance the upsurge of temporary expenses with an increased internal debt. A coefficient $a_3<1$ indicates that only a fraction of positive cycles in government expenses is financed by increases of internal debt. But once more the model is inconclusive about tax

smoothing; governments could avoid changing tax rates by using a combination of internal and external credit.

Regarding the coefficient a_4 we hypothesize a coefficient less than 1. The reasons for expecting $a_4 < 1$ are not based on theoretical considerations but on historical experience. In other place, we have emphasized the temporary and partial character of important increases in internal debt in response to sudden reductions in external financing. Then the proposed coefficient is $a_4 < 1$ ⁷.

To sum up, our empirical model inquires into the causes of deviations of internal debt from its historical trend. Shocks on output, imports, government expenditures and external financing are explanatory variables. The hypothesized magnitude of the coefficients $a_1 = a_2 = a_3 = 1$ corresponds to one of our paradigms, the tax-smoothing theory. Were the estimated parameters (a_1, a_2, a_3) close to 1, the evidence would favour that approach. However, by specification the model fails to recognize other possibilities of tax smoothing since estimated parameters such as $a_2 < 1$ and $a_3 < 1$ could be consistent with the actual validity of that framework. Finally, the inclusion of the once-lagged dependent variable within the explanatory variables suggests that not only shocks on the economic variables (Y, M, G, f), but also institutional factors associated with the way governments affect the maturity structure of the IPD cause internal financing to deviate from its historical trend.

D. Estimation and tests.

As seen in Table 1, the processes for all the variables in the estimating equation (9) are evaluated in terms of stationarity. The Augmented-Dickey-Fuller Test (ADF) and the Kwiatkowski-Philips-Schmidt-Shin Test (KPSS) are applied. The stationarity of Y_{u_t} is questioned under the ADF Test, but accepted under the KPSS Test.

Table 1

Unit Root Tests

Variables in the model for the shock-absorber role of the internal public debt

| Variables | Augmented Dickey-Fuller (ADF) | | | KPSS | | |
|-----------|-------------------------------|-----------------|----------------------------------|-------------------------|-------------------|----------------------------------|
| | Deterministic component | Test Statistic | Critical values ($\alpha=5\%$) | Deterministic component | LM-Test Statistic | Critical values ($\alpha=1\%$) |
| Fu_t | Intercept | $\tau = -3.071$ | -2.899 | Intercept | 0.087 | 0.739 |
| Gu_t | Intercept | $\tau = -4.586$ | -2.900 | Intercept | 0.158 | 0.216 |
| Mu_t | Intercept | $\tau = -3.089$ | -2.898 | Intercept | 0.049 | 0.739 |

^{7/} Avella (1988)

| | | | | | | |
|---------|----------------------------|-----------------|--------|----------------------------|-------|-------|
| Yu_t | <i>Trend and Intercept</i> | $\tau = -1.207$ | -3.469 | <i>Trend and Intercept</i> | 0.162 | 0.216 |
| $f'u_t$ | <i>Trend and Intercept</i> | $\tau = -4.618$ | -2.899 | <i>Trend and Intercept</i> | 0.060 | 0.216 |

Notes. In the case of the ADF Test, the deterministic component was chosen according to the sequential process suggested by Perron (1988). The Schwarz Information Criterion was applied in selecting the optimal lag length of the test regression. In the case of the KPSS test, the spectral estimation applied was the Bartlett kernel method. The bandwidth was selected according to the Newey-West criterion. Software. EViews 5.

The results in Table 1 allow us to apply classical OLS as method of econometric estimation. Table 2 displays the estimates of equation (9):

Table 2
Internal Public Debt
Estimated Cycles

| <i>Dependent Variable: RLORIPD</i> | | | | |
|------------------------------------|---------------------|------------------------------|----------------|--------------|
| <i>Estimation Method: OLS</i> | | | | |
| <i>Simple: 1926 2003</i> | | | | |
| <i>No. obs.: 78</i> | | | | |
| <i>Regressors</i> | <i>Coefficient.</i> | <i>S. E.</i> | <i>t-Stat.</i> | <i>Prob.</i> |
| Fu_{t-1} | 0.798734 | 0.053729 | 14.86610 | 0.0000 |
| Yu_t | -1.658977 | 0.415439 | -3.993311 | 0.0002 |
| Gu_t | 0.324381 | 0.141431 | 2.293557 | 0.0247 |
| Mu_t | -0.222458 | 0.091686 | -2.426296 | 0.0178 |
| $f'u_t$ | -0.124366 | 0.129920 | -0.957253 | 0.3416 |
| K | 0.832404 | 0.144445 | 5.762771 | 0.0000 |
| <i>R-squared</i> | 0.907457 | <i>Mean dependent var</i> | | 0.008986 |
| <i>Adjusted R-squared</i> | 0.9010313 | <i>S.D. dependent var</i> | | 0.627420 |
| <i>S.E. of regresión</i> | 0.0.197383 | <i>Akaike info criterion</i> | | -0.333541 |
| <i>Sum squared resid</i> | 2.805116 | <i>Schwarz criterion</i> | | -0.152256 |
| | | | | |
| | | | | |

Breusch-Godfrey Serial Correlation LM Test: $s_1(n)$

| | | | |
|---------------|----------|-------------|----------|
| F-statistic | 2.839782 | Probability | 0.065190 |
| Obs*R-squared | 5.848465 | Probability | 0.053706 |

ARCH Test:

| | | | |
|---------------|----------|-------------|----------|
| F-statistic | 0.249582 | Probability | 0.618832 |
| Obs*R-squared | 0.255387 | Probability | 0.613307 |

White Heteroskedasticity Test:

| | | | |
|-------------|----------|-------------|-----------|
| F-statistic | 2.097872 | Probability | 0.0137106 |
|-------------|----------|-------------|-----------|

Obs*R-squared 35.58907 Probability 0.033589

Jarque-Bera: 1.844 Valor-p: 0.3976

Software. [EViews 5](#)

Table 2 shows the OLS estimates for the full sample 1925-2003. The estimated shocks associated with output, government spending, imports and external financing exhibit the expected signs and are all, but the last one, significant at the 5% level. First of all, the estimated coefficient of the Y_{it} variable (-1.6, t-statistics: -4.0) reveals a strong countercyclical reaction of IPD to downswings in real GDP. Literally, a negative deviation of the growth rate of output of 1% relative to its historical trend causes internal financing to grow at 1.6% above its normal rate. As for shocks on government expenditures, the estimated coefficient indicates that a deviation of the growth rate of the IPD of 0.3% above its trend corresponds to an increase of the growth rate of government expenditures of 1% above their trend. Regarding negative shocks on imports and external financing, the estimates reveal also counteractive responses of internal debt. Finally, the estimated coefficient for the lagged dependent variable is highly significant and shows a marked sluggish adjustment of the internal debt.

What can we say about theory consistency?

Two issues are to be considered: the economic interpretation and the statistical characteristics of the estimates in Table 2. As for the economic interpretation we have already observed that the estimated parameters of the hypothesized explanatory variables are all but one significant, and the signs are as expected. The estimated value for a_1 indicates that the typical countercyclical reaction of internal debt notably exceeds the unitary coefficient which will correspond to automatic stabilization; by referring to our paradigms, this result suggests the presence of discretionary countercyclical measures beyond the operation of automatic stabilizers. Additionally, the coefficients' sizes imply that internal debt is used to finance only a portion of deficits arising due to either negative cycles of imports or huge temporary government expenses, but we are unable to conclude about the possibility of tax smoothing in these cases.

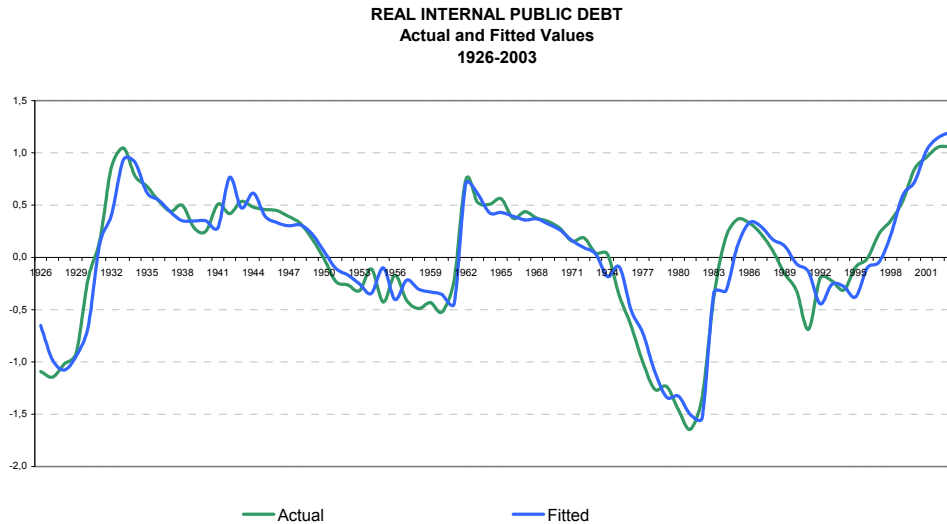
It is shown how the estimated value for a_4 supports the conjectured countercyclical and partial reaction of internal debt to shocks on external financing. Certainly, the estimated value for a_4 is not significant according to standard criteria. When regressions are performed for samples up to 1990, a_4 is clearly significant. Additionally, documental reports about fiscal policy illustrate how authorities had to recourse to IPD whenever they had to face the cycles of external financing. Having these considerations in mind, we decide to maintain the external financing as part of the set of regressors.

As for the statistical characteristics of the estimation, Table 2 also offers various criteria for evaluating our econometric model. First of all, the goodness-of-fit suggested by Figure 2 is confirmed by a high R^2 . Additionally, two sets of diagnostic tests insinuate the absence of a systematic lack-of-fit. These tests check for the presence of serial correlation and heteroskedasticity. $s_1(n)$ is the Lagrange Multiplier test for autocorrelation in its F-version⁸. $h_1(n)$ is the Autoregressive Conditional

^{8/} The LM test (Box and Pierce [1970] and Godfrey [1978]) is computed by regressing the OLS residuals e^{\wedge}_t on all the regressors of the original model x_t and the lagged residuals for lags up to n (e^{\wedge}_{t-1}).

Heteroskedasticity test ARCH presented here in its F form, and $h_2(n)$ is the test for heteroskedasticity due to squares of the regressors also in its F-form⁹. The results show that the estimated regression passes these tests.

Figure 2



NOTES. Fitted values: annual estimates of the deviations from trend of the real internal public debt according to the model in equation (9).

SOURCES. Informe Financiero del Contralor for the original annual data on nominal IPD, and DANE for the annual GDP deflator.

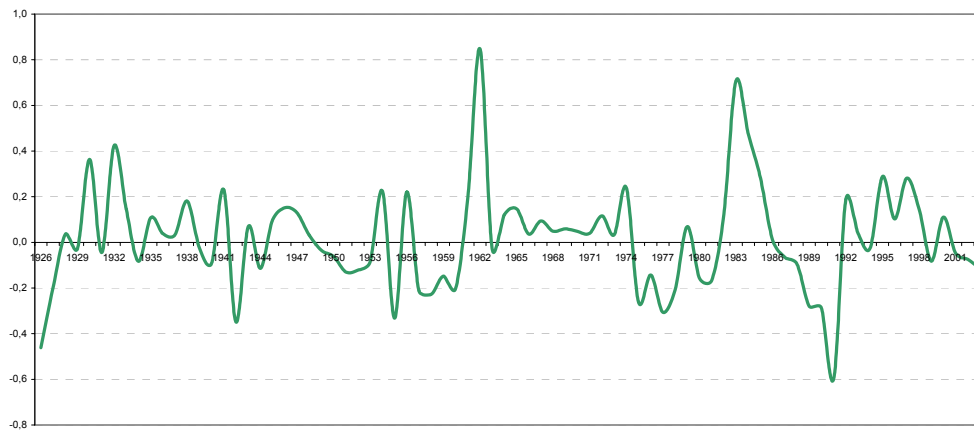
Figure 3 shows the time path of the residuals resulting from the OLS estimation of equation (9).

Figure 3

..., e^{\wedge}_{t-n}). The test statistic $s_1(n)$ is T (observations) times the R^2 for this regression. Kiviet (1986) finds that this version of the test has poor small sample properties and recommends the Lagrange Multiplier type F-test which seems to be invariant to sample size and redundant regressors.

⁹ Engle (1982) proposes a test for heteroskedasticity (the ARCH test) in which the e^{\wedge}_t are regressed on their lagged values. The test checks for the significance of the estimated parameters. The $h_2(n)$ test proposed by White (1980) is computed by regressing the e^{\wedge}_t on the regressors of the original model x_t and their corresponding squares x_t^2 . The null of homoscedasticity is tested against the alternative that the variance of the e_t is a function of x_t and x_t^2 . The test is also a general test for model specification. If the test is not statistically significant it implies that not only the variance specification of the model is correct, but also that the linear specification is correct. (White [1980] p. 823)

**Real Internal Public Debt
Estimated Residuals
1926-2003**



NOTES. Series of estimated residuals obtained from the OLS regression of the model in equation (9).
SOURCES. As in Figure 2.

Figure 3 suggests that the series is not afflicted by serial correlation or heteroskedasticity. A few extreme values are observed, particularly in 1983, but above all in 1962. So far our tests have not been affected by these unusually large values; such is the case of the normality test which by construction is sensitive to outliers. Finally, as expected from the stationarity of the regressand and regressors the estimated residuals are also stationary.

What can we add about parameter constancy? The point is important not only because the lack of regression parameter constancy is a cause of misspecification of estimating equations, but because it has to be shown that although the economic system experienced changes over the period of study, the model is characterized by parameters which remained fairly stable. In order to check for parameter constancy we reestimate the model by using recursive least squares (RLS). This estimation provides us with new diagnostic tools, namely, the RLS coefficients, and various Chow statistics, to which results we now turn.

The RLS coefficients allow us to follow the time paths of the parameters of the model over the period of study. The coefficients for βu_t and βu_{t-1} are very stable over the sample period. The coefficient for βu_t remains relatively stable over the period, and the same happens for the coefficients on βu_t and βu_t . The CUSUM test (based on the cumulative sum of the recursive residuals) and the CUSUM of squares test are also suggestive of parameter stability. To sum up, the recursive estimation of (9) shows that all the parameters are stable. An additional source of information about stability is provided by the Chow test. The test was performed annually between 1963 and 1983. The results reported parameter constancy over that period.

Finally, a common characteristic of all the regressions is the relatively high and strong significance of the estimate of the lagged value of the dependent variable. It reveals that an important feature in this historical analysis is the tendency to a slow adjustment of internal debt. Putting it other way, not only cycles in economic variables but the pace at

which the government amortizes the outstanding internal debt explains the cycles in internal financing. Various historical episodes endorse this statistical finding. For example, the extraordinary increase of internal public debt of the early 1930s, required four decades to be fully amortized.

Having interpreted our econometric estimations, we now turn to describe the evolution of the cycles of IPD (Figure 2) in the light of the cycles of the explanatory variables and the estimates reported in Table 2.

E. Behaviour of the cycles of the internal public debt, 1925-2003.

Graph 2 and Table 2 suggest that we can distinguish three main periods in the predicted time path of the cycles of IPD.

1. Mid-1920s to mid-1950s

Three phases can be observed during the first period: the second half of the 1920s which mostly coincides with the boom which precedes the great depression (1929-33); from the depression years to WWII; and the first post-War decade.

The first phase was dominated by a deep negative cycle of internal debt around its trend. The reasons for this negative cycle are to be found in the behaviour of output, imports, and external financing, all of which experienced growth rates notably above their trends. 1928 is a crucial date in the evolution of the series: output and imports reach their maximum positive deviations from trend ever, and external financing arrives at a point which could only be repeated towards the other extreme of the series in 1981. 1928 is also the year in which government expenditures reach their maximum growth rate above normal for the whole series (1925-2003); *ceteris paribus*, this behaviour of government expenditure contradicts our expectation of a positive relationship between Fu_t and Gu_t .

After 1928 the deluge: the access to external credit is virtually closed, imports fall sharply after 1929 and output slows down to achieve just its historical rate in 1931. As a result of these events, the deep negative cycle of IPD is transformed into a large positive cycle since 1931. This cycle reaches its maximum in 1933 and also high points in 1942-1945. What can we say about the behaviour of the individual explanatory variables which resulted in the positive cycle of the IPD? Note first the evolution of output. Along the 1930s output grows above its historical rate, with an average deviation from trend of 2%, lower than the average of 10% which predominated in the second half of the 1920s. In contrast, during the 1940s output grows below the historical rate, reaching during the War years the mayor negative deviations from trend for the whole period 1925- 2003.

Contrasting with the evolution of output, imports grow at less than their trend since 1930 and through the end of World War II. Two subperiods can be distinguished. The first starts with the great depression when the imports-growth rate collapsed from being on average 60% above trend in 1927-28 to being on average 65% below trend in 1931-1933. The end of this first subperiod coincides with a gradual recovery of imports which in the years 1937-39 regained the normal growth rate. The second downfall of imports

exactly corresponds with the World War II years. Once more, the average negative deviation from trend is 60% in the interval 1942-1944.

The behaviour of external financing between 1930 and 1942 adds new elements to the previous description. The boom of the late 1920s is abruptly replaced by the deepest downturn during the whole period, between 1930 and 1934; at its bottom in 1931 the growth rate of external financing represents a deviation of 57% from the normal growth rate. The magnitude of the collapse can be illustrated by the fact that the lowest growth rate is achieved only two years after the second highest growth rate of the series is reached; at this last point the positive deviation from normal is 49%. Towards the end of the decade external financing grows close to, but still below its trend. A different experience is to come about during the last three years of the War, however. The collapse of imports due to the hostilities, and unexpected capital inflows result in accumulating international reserves, and growth rates of external financing above trend; at its summit in 1945, these rates represent a positive deviation of 28% over the historical growth rate.

As for government expenditures, their behaviour appears to be dominated by policies of fiscal retrenchment since the late 1920s through the 1940s. The consequence of these policies is a long negative cycle of government expenditures around its trend, of which the following figures are illustrative. The average negative deviation from the normal growth rate in the years 1935-1938 is 19%. Thereafter, this restrictive behaviour reaches an average of 32% in 1943-1946, with a trough of 56% in 1943. Some isolated points reveal expansionary increases of government expenditures above normal, but there is only one outstanding experience, in 1933, when the "actual" growth exceeds the trend by 23%¹⁰.

Finally, some institutional facts appear to be influencing the positive cycles of internal public debt. These facts are summarized by the behaviour of Fu_{t-1} . Two important government decisions are worth noting here. First, the suspension of amortizations on the internal debt bonds between 1933 and 1940; and second, the conversion of medium-term credits granted to the government during the fiscal crisis of the early 1930s into long-term internal debt (An important credit received by the government from the central bank in 1931 was converted in 1942 into a debt which would be gradually amortized along the next 30 years). These facts contribute to a very slow adjustment of internal debt.

In conclusion, the individual behaviour of the explanatory variables during the second phase can be summarized as follows: imports consistently grow below their trend, thus clearly contributing to the positive cycle of the IPD. A less consistent behaviour is observed in the evolution of external financing and output. An apparent contrast is offered by the evolution of government expenditures which grow below their normal rate through the whole phase. Finally, the lagged value of the deviations from trend of the IPD seems to contribute to the permanence of the positive cycle of the internal public debt under discussion.

The third phase covers the first decade after World War II. During these years the growth rates (actual and predicted) of IPD continuously decline, reaching the historical

^{10/} The increase of government expenditures during 1933 was associated with recovery policies implemented after the Great Depression, and the financing of a war with a neighbouring country, Perú.

rate in 1950, and then, lower rates than normal during the first half of the 1950s. Regarding the behaviour of individual explanatory variables, it appears that while output and external financing grow below their trends, and government expenditures grow above their trend (altogether suggesting that the growth rates of the internal debt could be increasing), imports grow well above their trend. The imports boom triggered by the normalization of international trade at the end of the conflict, reaches its height in the period 1953-1956 when the average deviation of the growth rate of imports above trend equals 58%. As for government expenditures, it has to be noted that for the first time in twenty years their growth rates exceed the historical rate. In fact, the fiscal bonanza derived from the imports upsurge facilitates the increased government spending and allows internal debt to grow at a slower rate compared with the normal.

2. Mid-1950s to mid-1980s

Two phases stand out during these years. A new positive cycle of the IPD starting in the early 1960s to the mid-1970s and the period 1975-1985 which largely duplicates the experience with IPD in the late 1920s and early 1930s. The first phase is characterized by the following features: First, a negative cycle of imports which coincides with a negative cycle of world coffee prices. The second feature is a positive cycle of government spending particularly between 1967 and 1975, which reaches its peak in 1972, the second highest point in the whole series of government spending.

Third, as observed the evolution of output can be divided into two different subperiods. The first covers the years 1960-1968 when output grows at a steady rate of about 3% less than the trend. In the second period (1968-1975) output growth rates evolve consistently above trend, reaching levels not achieved before since the economic boom of the 1920s. Fourth, the external financing exhibits a series of no negligible ups and downs around the trend, which gives an impression of the financial instability of the period. On average, the external financing grows below trend. As a whole, with the only exception of output during 1968-75, the behaviour of the explanatory variables individually considered is consistent with the positive cycle of the internal public debt.

Why does the growth rate of IPD "jump" in 1962 as shown in Figure 2? 1962 was already an important reference in our previous discussion of parameter constancy. The outstanding change in the internal debt is produced by a combination of economic and institutional facts at the center of which there are substantial losses made by the central bank in the foreign exchange market which are transformed into internal debt. There are also other institutional facts which contribute to the "jump" in 1962 and which reappear later during the 1960s and early 1970s; such is the case of substitutions of internal debt for part of the external debt. It is as a result of these facts and the commented evolution of the economic explanatory variables, that the wave of increasing internal debt of the early 1960s extends its existence until the mid-1970s.

The second phase covers the last decade of our period of study. To an important extent the 1975-1985 period resembles the boom-and-bust cycles of the late twenties and early thirties. Two distinct features of the boom are the coffee bonanza of the years 1976-1980, and the access to external financing (1979-1982) on a scale not seen in the previous fifty years. In this context, a negative cycle of real IPD emerges and its deepest point in 1981 corresponds to the actual maximum negative deviation from trend in the whole period. This is only an ephemeral experience, however. The end of the temporary

boom of the external sector and particularly the sudden and abrupt collapse of external financing in 1982 brings about a new cycle of accumulating internal debt.

In the light of our explanatory variables how can we explain the negative cycle of IPD during 1975-1981? First, we note that the positive cycle of government spending which started in the mid-1960s comes to an end after fiscal reforms implemented in 1975. Second, output and imports grow at rates superior to their normal ones: the average positive deviation of output from trend in the years 1978-1980 is just somewhat inferior to that achieved in the boom of the late 1920s; as for imports, the new positive cycle though important and prolonged for six years, does not achieve the magnitudes of the twenties or the sixties. The scene is completed with the behaviour of external financing whose positive cycle echoes the experience of the late 1920s; its average positive deviation from trend in the years 1979-1982 equals 34% compared with 40% in 1926-1928. The sharp increase in foreign financing since 1979 reaches its summit in 1981, which is at the same time the maximum positive deviation from trend of the whole series. Altogether, the large positive cycles of external financing and output contribute to explain the deep negative cycle of IPD during 1975-1981. This contribution is supplemented by a positive cycle of imports and by a negative cycle of government expenditures, although in the last case only until 1978.

If the interval 1975-1981 parallels some episodes of the 1920s, the crisis which explodes in 1982 reproduces experiences lived through in the early 1930s and leads to a new cycle of IPD growing above the historical trend. The economy already affected by the recessionary effects of the end of the coffee bonanza faces the breakdown of foreign lending in 1982. This crisis, however, is not as deep, prolonged and dramatic as its precedent of the 1930s which included an "official debt default". Following the downturn of external lending, a new negative cycle of foreign financing emerges: during 1983-1985 its average negative deviation from trend reached 18% compared with the average positive deviation of 34% achieved during the booming period 1979-1982. The lesser magnitude of the falldown of external financing in 1983-85 compared with that of 1930-1932 is illustrated by the fact that the average negative deviation from trend in the latter period was 44%, far greater than the 18% of the former period.

Also negative cycles of output (since 1982) and imports (since 1983) appear after the end of the coffee bonanza and the drying up of foreign credit. Altogether, the individual behaviour of f_{u_t} , Y_{u_t} and M_{u_t} contribute to explain the new positive cycle of IPD. Regarding the behaviour of G_{u_t} , the experience of the late 1920s and early 1930s is repeated here. A positive cycle of government expenditures during 1979-1984 coincides with the negative cycle of IPD during most of that period. In the late 1920s the positive cycle of government expenditures was largely financed by a positive cycle of tax revenues derived from booming output and imports. In the early 1980s the positive wave of government expenditures was mostly financed by financial proceeds obtained by the government from the investment and management of the unprecedented stock of international reserves left by the coffee bonanza of 1976-1980.

3. Mid-1980 to 2003.

The last twenty years of the series under scrutiny reveal the succession of two phases. The first one corresponds to the second half of the 1980s and the first half of the 1990s, when IPD was falling to its steady state. It was a period of fiscal adjustment, with public

spending growing at a rate below the historical one, and output growing above the normal. Along the last eight years of the sample, IPD grows continuously reaching its highest point in the whole series, around 2002. In the background, government spending was increasing above its historical standard, real imports were also falling, and external financing collapsed after booming between 1992 and 1996.

1991 is an outstanding point in the institutional history of IPD. As part of a thorough constitutional reform, the central bank was given a new role, and the monetary financing of the budget deficit was tightly restricted. Only with the unanimous vote of the monetary board could the government have direct access to loans of the central bank. In the past, Congress could create credit lines in the central bank in favor of the government. That possibility was abolished. It was also banned the access of the private sector to central bank's loans. As from 1991, the sources of IPD should be the internal markets for government bonds, and commercial banks for short-term credits. Since 1999 the Banco de la República has performed Open Market Operations intervening in the market of IPD bonds.

As seen in Figure 1a. and also in Figure 2, the experience with the cycle of IPD since 1992 has resembled the experience of the 1920s and early 1930s. In the 1930s the upsurge of IPD was clearly determined by the reflationary policies implemented in the midst of the great depression. At that time the indebtedness with the central bank was a crucial component of the cycle of IPD. Things have been different since the early 1990s. Governments have floated bonds in internal capital markets in a rather unusual way. Contrary to the experience of the 1930s, when the expansionary policies financed by the IPD were followed by policies of drastic fiscal adjustment, in the 1990s the positive cycle of IPD has not been followed by fiscal retrenchment in a comparable way with what happened seven decades ago.

F. Conclusions

In this essay we formalized our historically-based hypothesis of the shock-absorber role of IPD. By starting from the government budget constraint we derived a model according to which IPD deviates from its historical growth rate due to shocks on a set of hypothesized explanatory variables. In the absence of these shocks, the IPD grows at its historical rate.

According to the empirical results, shocks on the explanatory variables are significant and exhibit the expected signs. Overall, all the estimations satisfy standard criteria for evaluation of econometric models.

Regarding the theoretical paradigms recalled at the beginning of the paper, the estimation applied to the entire period of study suggests that the Colombian experience is better represented by paradigms which recognize the role of discretionary countercyclical policies over the business cycle. This finding is mainly associated with the significant estimated parameter for the output variable which turned out to be far greater than unity. Unfortunately, the specification of the model did not allow us to derive more explicit conclusions about the relevance of individual paradigms for the interpretation of the Colombian case.

To sum up, our statistical results offer an encouraging support to the hypothesis that internal public debt has performed a shock absorber role in Colombia.

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Appendix A

Table A. 1
Summary of Unit Root Tests
Original variables of the estimating model in logs

| | <i>Augmented Dickey-Fuller (ADF)</i> | | | <i>KPSS</i> | | |
|------------------------------------|--------------------------------------|-----------------------|--|--------------------------------|--------------------------|--|
| | <i>Deterministic component</i> | <i>Test Statistic</i> | <i>Critical values ($\alpha=5\%$)</i> | <i>Deterministic component</i> | <i>LM-Test Statistic</i> | <i>Critical values ($\alpha=1\%$)</i> |
| Real Internal Public Debt | <i>None</i> | $\tau = -2.376$ | -1.945 | <i>Trend and Intercept</i> | 0.094 | 0.216 |
| | | | | <i>Intercept</i> | 1.094 | 0.739 |
| Real Government Expenditure | <i>Trend and Intercept</i> | $\tau = -4.614$ | -3.470 | <i>Trend and Intercept</i> | 0.158 | 0.216 |
| Real Imports | <i>None</i> | $\tau = -0.657$ | -1.944 | <i>Intercept</i> | 1.134 | 0.739 |
| Real Output | <i>Trend and Intercept</i> | $\tau = -1.17$ | -3.468 | <i>Trend and Intercept</i> | 0.170 | 0.216 |
| External Financing | <i>Trend and Intercept</i> | $\tau = -4.659$ | -3.467 | <i>Trend and Intercept</i> | 0.062 | 0.216 |

Notes: In the case of the ADF Test, the deterministic component was chosen according to the sequential process suggested by Perron (1988). The Schwarz Information Criterion was used in selecting the optimal lag length of test regression. In the case of the KPSS test, the spectral estimation method used was Bartlett kernel, and the bandwidth was selected according to Newey-West criterion.

Because the Real Imports variable does not pass the previous tests, and after observation of the evolution of the series, we perform a Perron's unit root test for the presence of a structural break in 1945, as shown in Table A2:

Table A2
Perron's Unit Root Test in presence of Structural Breaks
Real Imports

| | | | | |
|--|--------------|--------------|----------------|--------------|
| <i>Dependent Variable: LORUSIM</i> | | | | |
| <i>Estimation Method: OLS</i> | | | | |
| <i>Sample : 1928 2004</i> | | | | |
| <i>Included observations: 77</i> | | | | |
| <i>Type of model: Changing growth model, structural break in year 1945</i> | | | | |
| | | | | |
| <i>Variable</i> | <i>Coef.</i> | <i>S. E.</i> | <i>t-Stat.</i> | <i>Prob.</i> |
| <i>C</i> | -0.627862 | 0.140245 | -4.476909 | 0.0000 |

| | | | | |
|----------------------------------|-----------|-------------------------------------|-----------|--------|
| <i>DU</i> | 0.163167 | 0.114113 | 1.429875 | 0.1572 |
| <i>@TREND</i> | 0.015224 | 0.008521 | 1.786565 | 0.0783 |
| <i>DT*</i> | -0.001732 | 0.009136 | -0.189568 | 0.8502 |
| <i>LORUSIM(-1)</i> | 0.568542 | 0.086883 | 6.543787 | 0.0000 |
| <i>D(LORUSIM(-1))</i> | 0.245380 | 0.106916 | 2.295063 | 0.0247 |
| <i>D(LORUSIM(-2))</i> | 0.314095 | 0.109112 | 2.878650 | 0.0053 |
| | | | | |
| <i>R-squared</i> | 0.958418 | <i>Mean dependent var</i> | 0.189143 | |
| <i>Adjusted R-squared</i> | 0.954854 | <i>S.D. dependent var</i> | 0.879663 | |
| <i>S.E. of regression</i> | 0.186908 | <i>Akaike info criterion</i> | -0.429892 | |
| <i>Sum squared resid</i> | 2.445423 | <i>Schwarz criterion</i> | -0.216819 | |
| <i>Log likelihood</i> | 23.55084 | <i>F-statistic</i> | 268.9020 | |
| <i>Durbin-Watson stat</i> | 1.955252 | <i>Prob(F-statistic)</i> | 0.000000 | |

Notes: Unit root test regression suggested by Perron (1989) allowing for a one-time shift in trend. DU is a dummy variable that takes the value of 1 after the moment of the structural break (1945) and zero otherwise. DT* is a dummy variable that takes the value of 1,2,3,4,... after the moment of the structural break and zero otherwise. LORUSIM es el logaritmo de las importaciones reales en dólares.

The Perron's test-statistic for the null hypothesis of unit root is calculated as follows:

$$t_{\alpha} = \frac{(\text{Coef}_{LORUSIM(-1)} - 1)}{S.E.\text{Coef}_{LORUSIM(-1)}} = \frac{0.568542 - 1}{0.086883} = \frac{-0.431}{0.086} = -4.96$$

According to the Table V.B. in page 1377 of Perron (1989), critical values for this test are between -3.80 and -3.87. In either case, the null hypothesis is rejected in favor of the alternative of stationarity around a breaking trend.

Because all the series are stationary at least with one unit root test, each one of them has been detrended by means of the OLS estimation of a linear trend¹¹. The residuals of this detrending procedure have been used in the estimation of the model. As Table 1 puts forward, the residuals are also stationary according to both ADF and KPSS test, excepting the residuals of LORGDP which are stationary under the KPSS unit root test.

¹¹ The LORUSIM series has been detrended taking into account the presence of a structural shift in the trend in 1945.